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Abdominal Surgery.

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ABDOMINAL SURGERY

LANE LIBRARY

BY

HAL C. WYMAN, M. S., M. D.,

Professor of Surgery and Operative Surgery, Michigan College of Medicine and Surgery; Surgeon to the Detroit Emergency Hospital; Special Lecturer on Surgical Physiology, Minnesota Hospital Medical College; Member of the American Medical Association, Michigan State Medical Society, Detroit Academy of Medicine, Michigan State Board of Corrections and Charities; Vice-President Michigan Society for the Prevention of Cruelty to Animals and Children.

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DEDICATION.

TO MY FATHER,

HENRY WYMAN, M. D.,

WHO FOR MORE THAN SIXTY YEARS HAS PRACTICED
THE HEALING ART, AND WHOSE WISE COUNSELS
HAVE GUIDED ME SAFELY THROUGH
MANY TRYING ORDEALS, THIS
WORK IS DEDICATED,
BY THE AUTHOR.

PREFACE.

There have been few writers on any subject who have not deemed it necessary, when undertaking the presentation of their ideas in cold type, to explain to their possible readers why they have made the venture. Accordingly, not desiring to make myself conspicuous by failing to observe a custom so old and, generally speaking, so valuable, I desire to make the following announcement.

The purpose of this work is to aid students and practitioners in the elementary study of abdominal surgery by a plain presentation of facts, examples and results as they have come under my notice in my own investigations and practice of that department of the healing art. While literary excellence will be sought to the very best of my ability, I shall always have my doubts as to results in that direction; but when that for which the work has been prepared—the aid of students and the inspiration among them of a spirit of investigation in the line of such surgery, when that is considered, I shall rest content in the conviction that I have as plainly as possible for me to do, made a frank, honest statement of facts as they have been revealed to me.

The firm and unquestionable position attained by Abdominal Surgery within the past few years, renders this branch of surgical science of vital interest to every practitioner who is ambitious to keep abreast of the times.

It has secured a footing which renders it imperative that all practitioners should familiarize themselves with the technical details of the work.

Realizing this proposition to be a true one, my mind was attracted to a consideration of the facilities and opportunities for acquiring such knowledge, possessed by medical men generally. Their field is a vast one, there are few or none having a greater area, and for that reason, it was impressed upon me that the work I contemplated might prove a welcome one. If you will consider how small a proportion of the members of our profession are so located as to have at hand all the clinical material and other benefits so abundant about the large hospitals in the leading cities of this country, you cannot fail to appreciate the too palpable fact that thousands of surgeons, both old practitioners and young ones, are necessarily obliged to pursue their investigations under great disadvantages, not the least among which is the provision of one's own clinical material—the creation of one's own opportunity, so to speak.

It is for such reasons that hundreds of surgeons, especially those whose "rides" are far away from the centers of population, are very often indeed called upon to perform operations which they have never seen performed. Every physician knows what an experience that is, and to the credit of the profession be it said, they have a sacred confidence and courage in their knowledge of nature's laws and requirements which, coupled with a reverential appreciation of the dignity and honor conferred upon them by being called upon to aid nature, enables them to undertake, and generally with success, anything their mistress, Nature, sets before them as a task.

The young surgeon who would refuse his patient the benefits of an operation for hernia, simply because he had never seen such an operation performed, would not deserve the respect of the profession nor the confidence of his *clientelle*.

How, then, can a student not in reach of hospitals and an abundance of opportunities and material, attain that degree of knowledge which shall give him that confidence so necessary to the conscientious, good surgeon?

He must do it by providing his own opportunities and material.

Where can the necessary material be obtained?

For answer, I say, search the kennels and the hutches about you. Hunt up those oft tried, faithful and most efficient martyrs who give their lives to the cause of science—the dogs and rabbits.

Vincent Boune's *Epitaphium in Canem* ought to be read and appreciated by everyone who undertakes a vivisection.

Dogs have rendered inestimable aid in evolving the numerous great surgical discoveries which have added so much to the years and comfort of mankind. With the aid of dogs hundreds of ambitious, enthusiastic surgeons have been enabled to make successfully the studies necessary for an understanding of the means by which nature repairs damage.

Parenthetically, I wish here to state that I have great faith in the life-saving value of abdominal surgery, yet I do not believe I am a "crank" on the subject. No man is more firmly set than myself, against that blood-loving, chance-taking recklessness so sententiously if not elegantly expressed by the phrase: "belly rippers."

Abdominal surgery, as I believe, should be practiced (in its present state of developement at least) as a last resort, and so practiced the most successful operator, in my opinion, will be the one who is quickest to decide accurately when death is at hand, when the "last-resort-opportunity" is offered.

CHAPTER I.

ABDOMINAL SURGERY.

HOW TO BEGIN THE STUDY.

Accepting dogs and rabbits as the best available aids provided by Nature for experimental study, surgeons can in all humanity do no less than see to it that the sacrifice is painless. Its purpose makes it holy, and he who practices vivisection in any other spirit commits an offense unworthy of the manhood necessary for the production of a skilled surgeon. Hence see to it, invariably, that the animal or subject is properly anæsthetized before the operative studies are begun.

THE KINDS OF ANIMALS.

Rabbits.— The largest rabbits of the domestic breeds should be chosen, and they should not be too old or in poor health.

Dogs.—Of all breeds, the shepherd or colie dog is best suited to our purpose, because they are most docile and intelligent, and therefore are more easily restrained and managed during the very important period of convalescence from wounds. Their size, too, is a very decided advantage, as they are nearly on an equality with man in that respect, as they are in general shape and the location of the alimentary canal.

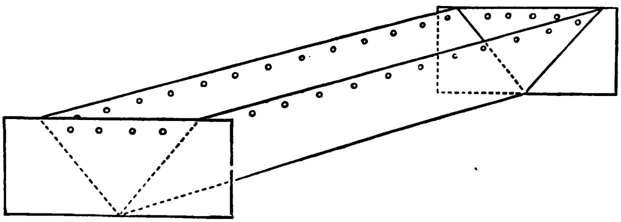
The ordinary black-and-tan dog is very valuable to the investigator, because, being very numerous, they are readily obtained, and because, by their hardihood, they are enabled to tolerate the operations of the experimenter very well. While the colie is preferable, he is also somewhat rare, in this part of the country at least; on the other hand, the black-and-tan will be found to do good service, and is numerous.

I do not mean to be understood as advising the student to confine himself strictly to the use of dogs and rabbits, as I mention them chiefly because of their availability. Other animals—sheep, swine, cattle, horses, and even the common house or domestic cat may also prove useful in the acquirement of the technique of the work under discussion.

HOW TO SECURE THE SUBJECT.

In handling a dog preparatory to the beginning of an experiment or investigation, it is well to gain so far as possible the confidence of the animal. The most important detail, however, is to fasten him securely before administering the anæsthetic. Don't try to get him under the influence of the anæsthetic before fastening him, thinking that by so doing you can fasten him more easily. It cannot be done, because the natural opposing struggles of the animal against the effects of the merciful agent invariably embarass the anæsthesia and surgical work.

In handling dogs or cats I have invariably first covered their jaws with a muzzle, then I fasten them in a device which has proved very serviceable and which I describe as follows:



It will be seen that the device is a simple V-shaped trough. I made mine 4½ feet long with the sides 10 inches wide. For the sake of cleanliness I left a small opening between the lower edges of the side pieces. To guard against the tipping over of the trough I have end pieces somewhat longer than the width of the device.

Along the upper edges of the side and end-pieces I had small holes (marked with a cipher), bored at frequent intervals, furnishing fastening places for the straps or ropes with which the animal is bound. A dog laid on his back in such a trough with his head fastened to an end piece and his legs fastened to the side pieces, has no alternative. He must lie still and very still. Struggle as he may he cannot get away from the anæsthesia nor will his few slight movements interfere with the operator's hands, arms or instruments.

ANÆSTHESIA.

As dogs are peculiarly susceptible to chloroform poisoning (I say, dogs for that animal more frequently than any other has been used in my investigations), I recommend ether as the anæsthetic to be used. Having placed your subject under the influence of the anæsthetic you must carefully notice the effect which is exerted in consequence, over the frequency and character of the respiration. The behavior of the heart must also be observed and this may be accomplished by pressing the finger upon the arteries of the neck.

Extreme care must be taken to guard against failure of heart action or of respiration, as they are possible results much to be dreaded. Especially is this the case when a human being is the subject of anæsthesia, therefore it is fortunate that the inquiring, painstaking student can improve his opportunity for the study of these phenomena and their premonitory signs, by observing dogs as they are passing under the influence of chloroform or ether. The indications and warnings are quite the same as are given by the human being, under like conditions.

ANTISEPSIS.

I desire that this sub-head shall be considered most seriously, conscious that my inability to present this topic with the impressiveness it deserves must be counteracted by the care and devotion with which what I may say shall be considered by my readers. Perhaps the greatest danger liable to attend an abdominal operation, is infection.

Too great care to provide against the misfortune of infection cannot be taken and under no circumstances may expedition in the performance of an operation, be gained at the expense of precaution.

In operating upon a dog, you must first see to it (and personally is the surest way) that he has been thoroughly washed, first with potash soap and then with a 5-per-cent. carbolic solution. Then, the room in which the operation is to be performed (whether it be upon a dog or upon a human being), if thorough antisepsis is to be maintained, must be washed with a 5-per-cent. carbolic solution, or with a two to a thousand corrosive sublimate solution.

The instruments, too, should all be immersed in some antiseptic solution. Hydronaphthol is excellent for this purpose, as it does not corrode metal or impair the cutting edge of a knife. In this question of instruments I wish to protest most firmly against the use, in abdominal operations, of instruments having split handles, sunken blades, pivot joints or hinges and other receptacles for infectious matter. I believe that all scissors, forceps and knives used by the operator in abdominal surgery, should be made with handles and blades of continuous pieces of metal with adjustable joints or hinges. The faulty instruments to which I object are, I believe, responsible for a very large percentage of bad consequences resulting from infection.

The Operating Room.—If the atmosphere of the operating room is impregnated with chloroform vapor—which is antiseptic—the brief time the peritoneal cavity is open will hardly suffice for infection.

Additional Precaution.—In case your patient is a member of the human family, and you attempt antisepsis, do not fail to require (in addition to the thorough bathing and cleansing mentioned in preparing dogs for an operation) that every article of clothing upon the patient and about the bed shall have been washed in antiseptic solutions and thoroughly dried.

And, finally, require and insist that the operator and his assistants, including nurses, shall wear clothing which has been especially treated for the occasion.

A famous Swiss surgeon has this notice posted upon the door of the room in which abdominal operations are made:

"NO ADMITTANCE TO PHYSICIANS OR STUDENTS WHO HAVE BEEN IN A DISSECTING ROOM OR NEAR A CORPSE WITHIN THE LAST 36 HOURS."

The Operator's Hands.—The hands of the operator must be, before any operation is begun, thoroughly cleansed by washing, and the washing and cleansing of a surgeon's hands has grown to be an art "since those organs are the commonest vehicles of infection."

Use hot water and plenty of potash soap, first. Then use an antiseptic wash of 5 per cent. carbolic acid or a two per thousand of corrosive sublimate, chlorine water or chloroform water. The writer esteems highly the last named wash both for the hands and for instruments, in addition to mere washing.

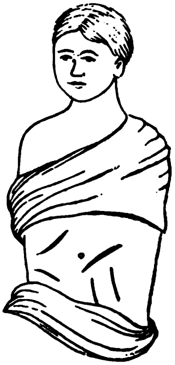
The nails must be most carefully brushed and cleansed. A distinguished English surgeon when asked as to his remarkable success in abdominal surgery, replied: "I always keep my finger nails clean."

Remember that your success in an operation may be totally defeated by failure in this matter of cleanliness and antisepsis, and bear in mind that any precautions used must be taken before an incision is made. Sepsis after abdominal incision is often carried, and it may be carried by any one of the vehicles mentioned—the clothes, the atmosphere, the instruments or the hands. Dogs are almost as liable to it as are human beings, hence the same thorough care is needed in their case as in the treatment of humans.

THE INCISION.

The regional anatomy of dogs is very similar to that of man so far as the surgical features are concerned; however, in all cases, before deciding upon the location of an incision to be made through the abdominal wall, one must consider the regional anatomy of the abdomen. While in a great majority of instances any operation can be performed upon the abdominal viscera through a wound made in the *linea alba*, still certain organs may be more easily approached by an incision made through the abdominal wall directly over them.

While, as has already been said, there are but slight differences between the regional anatomy of dogs and men, when surgically considered, the abdominal rings through which hernias protrude are so different in a dog from those in men that one cannot get a good surgical idea of hernia from canine studies alone.



The above cut is copied from a small work entitled Miniatur Abbildungen der Wichtigsten. Akiurgischen

Operationen by Dieffenbach, the famous German Surgeon, in 1838.

The seat of the abdominal lesion should govern the selection of the place to make the incision.

The gall bladder, for example, can be more easily reached through a wound directly over it than through one made in the median line of the abdomen below the umbilicus.

Many other organs bear the same relation to an incision in the *linea alba*, the alleged "line of safety."

It gives a good representation of the opinions held at that time by the leading surgeons in the earlier half of the present century, as to the location of the abdominal incision, and shows that they by no means ignored incisions remote from the median line being fully acquainted with the mobility of the viscera.

THE CONCLUSION OF ANTISEPSIS.

This period comes with the closure of the abdominal wound, it being assumed that the edges of the incision are so evenly approximated and so securely fastened by sutures and dressings that there is left no opportunity for germs to pass into the peritoneal cavity.

When dogs are the patients, the surface of the wound should be covered with zinc-milk (a mixture of zinc oxide and water, ℥ i and aqua o⅛) because the gauze and protective so commonly used are very easily torn off leaving a small area of raw surface exposed.

CHAPTER II.

BLOWS UPON THE ABDOMINAL WALL.

The frequency of death after blows and kicks have been inflicted upon the abdominal wall, makes it desirable to have more available knowledge as to lesions of the abdominal viscera caused by external violence, than is commonly found in text books on surgery. Hence I give the following results of some of my own experiments, not that they may not have been repeatedly duplicated by others, but that so far as I know through reading and observation, similar experiments have not as yet been described in print.

THREE MEDIUM SIZED DOGS

were made the subject of experiment. They were muzzled and tied standing on all fours.

A burly negro coachman, with no fondness for dogs, was directed to kick with his heavy boot each dog, three times in the abdomen. This he did, viciously and cruelly, as a most angry man might kick his fellow man in a street brawl.

No anæsthetic was given because, by arresting the contractile power of the abdominal muscles the influence of those muscles (1) as protectors of the abdominal viscera would be impaired and the experiment would not give a fair idea of the damage the viscera are liable to sustain by external violence.

Note (1)—The writer has seen cases illustrating the power of the abdominal muscles in diverting missiles from a course tending to penetrate the abdominal cavity. An athletic young man became involved in a personal encounter of great violence and bitterness, and getting the better of his antagonist the latter drew a revolver and fired point-blank. The ball struck the abdomen about one inch to the right of the umbilicus and traversing the abdominal muscles (apparently the abdomen), emerged from the lumbar region about the middle of the left *quadratus lumborum* muscle.

A soft-rubber catheter following the track of the ball, showing that the latter had been deflected from its course by the tense fibres of the *rectus abdominis*, and obliqus externus muscles taking the devious route described.

In two other cases, men working with an edging-saw were struck by pieces of edging which caught in the saw teeth and were hurled with terrible force against the abdomen, tearing the integument and fascias frightfully. The missiles were, however, deflected from their course by the contractile power of the abdominal muscles.

The transverse and oblique arrangement of the abdominal muscles provides an apparatus which will, in a great many instances, deflect missiles from a course which otherwise would penetrate the abdominal cavity.

Of the three canines injured as above described, one suffered no apparent disturbance, but two sickened and evinced serious abdominal disease.

The abdomen of one dog was opened 26 hours after the experiment and a rupture of the ileum was found. Fecal matter escaped into the peritoneal cavity and set up an inflammation which had glued considerable portions of the intestines together. The rent was closed by sutures, but the animal died and the autopsy showed that the sutures had torn out and allowed the intestinal contents to again escape.

The other dog was not operated upon, but died five days after the receipt of the blows and an autopsy showed that death resulted from peritonitis. Much pus was found in pockets which had been made by lymph gluing parts of intestines together. This showed that kicks upon the abdomen may frequently cause rupture of the intestine, peritonitis and death.

BLOWS UPON THE ABDOMEN.

Another medium-sized dog was taken and after being securely fastened in the trough as previously described, he was chloroformed. A 12-pound dumbbell was then allowed to fall a distance of eight feet and strike squarely upon the abdomen. The anæsthesia was discontinued and the dog was released and given his liberty in a small open-air enclosure. The effects of the anæsthetic masked any symptoms of the shock, although he exhibited signs of pain. Soon his abdomen became distended, he refused food and died from peritonitis the third day after the injury.

An autopsy showed some pus and bloody serum in the peritoneal cavity, rents were found in the jejunum, from which small quantities of intestinal contents had escaped. Masses of intestines were matted together in a way to indicate that Nature had attempted to prevent thereby further loss of intestinal contents, and to bring about a sort of intestinal anastomosis so that matter discharged from one opening could re-enter the *prima via* by the other opening. The putrefactive or poisonous ferments free in the peritoneal cavity were, however, too much for the vitality of the dog. He had apparently died from acute sepsis. The remote cause of death was an injury—rupture of the jejunum by a blow upon the wall of the abdomen.

The same "accident" was attempted on several other dogs, but with the successful rupture of the intestine in only one instance.

The studies showed, however, that it would appear to be necessary to have the weights and blows strike the abdomen in such a way as to have the force impinge upon the vertebral column. Then, if coils of intestine interposed they would be cut or ruptured; if they did not, the abdominal parieties were quite likely to be divided.

It would seem that the intestinal wound was a consequence of a sort of *counter coup*. A few studies of this character will demonstrate the real physical danger associated with blows upon the abdomen. Physiologists have talked so much of the inhibitory consequences upon the heart, of blows in this region, that practitioners have thought too much of the somewhat vague state of the animal economy known as shock, as a consequence of blows upon the abdomen. It is better surgery to explore the abdomen when the symptoms are grave.

AVOID CONTENTION.

A great deal has been heard in the past, from non-professional friends and through the columns of the daily press, in relation to vivisection and the students inquiring into the science of physiology, which, to the sensitive disposition, is decidedly unpleasant and unfortunate; I say unfortunate because both parties to the suit are innocent. The complainant sees only his side of the argument and has no especial reason to equip himself to understand and appreciate the side he is opposing, hence it is useless to upbraid him or contend with him. On the other hand the student of physiology while he may be and probably is as sympathetic as the layman, sees in his work only the great benefits to be brought to the human family, and accepting the divine dictum of his chosen profession, follows the compulsory laws set up for him by nature. He follows them to the very best of his ability with absolute earnestness of purpose, sure faith and conscientiousness, and all of that human sympathy possible to be felt and extended by his well meaning but misinformed critic.

I am prompted to this parenthetical proposition by a conviction that the student of abdominal surgery will find, if he experiments among the lower animals as I have done, that he is liable to possible hindrance and annoyance—especially if he be of a sensitive nature—by what may be by him overheard, received by mail or brought through the newspapers, in relation to his work or the work of similar investigators. "Be sure you are right, then go ahead," is the motto of the student who would learn the peritoneum.

CHAPTER III.

FUNCTIONS OF THE PERITONEUM.

As to the effect of wounds of the peritoneum, much that is valuable and interesting may be learned by experiment and investigation. The subject is by no means worked out as yet, and to test this matter for one's self and arrive at some personal experience and definite knowledge of the amount of trauma which this very sensitive membrane will tolerate, cannot but result beneficially to all who indulge in the work.

In my own first efforts in this direction I was guided by a description I had seen in an old surgical work of a method of uniting the intestines when they had been divided by wounds. I opened the peritoneal cavity of a dog by making an incision in the median line of the abdomen. I then excised through this wound, a portion of the intestine and united the cut surfaces by interrupted sutures. My studies were not sufficiently minute, so that I united the cut surfaces of the gut with too little care and without much reference to the different physiological characters of the several coats of the intestines. Hence, when I made a post-mortem examination a few days later I found a considerable portion of the intestinal contents free in the abdominal cavity, into which they had escaped through the wound I had closed imperfectly and improperly. My error was in my failure to consider properly the influence the various coats of the intestines might have upon the healing process.

I had made the effort (and naturally failed) of uniting two mucous surfaces together, the failure being because two mucous surfaces covered with normal mucous epithelium and normal mucous membrane were never intended by nature to blend together in the healing process.

Had I pushed the mucous surface into the cavity of the bowel and carefully approximated the peritoneal surface of the wounded intestine, my success would have been complete, because, as many subsequent experiments have shown, the function of the peritoneum appears to be to sustain and carry forward a large amount of plastic inflammation for the repair of injuries to the intestines.

In the dog's case, so much had the peritoneum been inflamed by the original wound and by the contents of the intestines, which had been turned into the peritoneal cavity, that large masses of the peritoneal surfaces and intestines were glued together by great flakes of organized lymph which had exuded from every part of the peritoneum that had sustained any damage. It was plain to be seen that Nature had attempted, by this copious peritoneal exudation, to cover up and heal the mucous areas I had deliberately, but not intentionally, made in the intestinal wall.

ACUTE PERITONITIS.

With deep interest as to how the peritoneum would behave when attacked with such general inflammation as I have seen described as following in the wake of operations in the peritoneal cavity, I made experiments in the artificial development of a general peritonitis.

My first experiment resulted in very extensive inflammation, although remote parts of the peritoneum did not appear to have been in any way affected by the injury and its consequences. So, with my second dog, I simply lifted the abdominal wall between my fingers to hold it away, if possible, from the abdominal viscera while I inserted an ordinary hypodermic syringe, by means of which I injected into the peritoneal cavity about half a drachm of aqua ammonia.

This injection caused an exhibition of the most intense pain. Every medium of expression, every organ that was capable of indicating pain was excited to the highest degree. I could not but shudder, though prompted by the most enthusiastic desire to discover a means of relieving an almost invariably fatal disease in men, at the agony of the suffering brute.

This intense pain was not for a few moments only, but it continued for hours. The respiration rapidly increased in frequency, the eyes seemed to sink back into the head of the animal and as the distension of the abdomen increased with gas, a touch, be it ever so gentle, upon the abdominal surface provoked a cry. Food was not taken and vomiting came on to increase in frequency until the dog died, about twelve hours after the injection.

An autopsy discovered the peritoneal membrane very much reddened and a considerable quantity of reddish colored fluid free in the peritoneal cavity; the ammoniacal odor had entirely vanished.

In some parts of the the abdominal cavity the peritoneal surface of the intestine was covered with flakes of adherent lymph, but the main feature of the case was the considerable amount of reddish-yellow fluid which was free in the peritoneal cavity and which was probably the result of transudation through the peritoneal blood-vessels, for no solution of continuity existed in any part of the abdominal cavity.

CHAPTER IV.

UNION OF ABDOMINAL WOUNDS.

My next study was with the object of learning the best method of closing the abdominal wound. For this purpose I operated on a large-sized dog, making a free incision. After making a thorough digital examination of the abdominal cavity, I closed the wound by sutures passed as follows: in the upper part of the wound they were made to embrace the integument and muscles at about one-half inch from their cut margin and excluding the peritoneum, which was left to unite without the introduction of art. In the lower part of the wound the sutures were made to embrace the peritoneum as well as the skin and muscles—all the tissues of the abdominal wall—so that two peritoneal surfaces were brought in contact with each other. Thus, it will be seen I had promise of two examples in one.

Following this operation the dog appeared quite ill for 48 hours, at the end of which time he began to improve, took more notice of his surroundings and ate some food. At the end of a week he had developed a hearty appetite and pulled all the sutures from the wound with his teeth. I felt that he was thoroughly convalescent, and in order to study the difference in the two methods—extra and intra peritoneal—of passing the abdominal sutures, it became necessary to kill him. This was done by puncturing the *medulla oblongata* with an awl.

I then opened the peritoneal cavity by making a transverse incision across the front wall of the abdomen. The following conditions were revealed. The lower portion of the original wound was completely closed by a firm, narrow cicatrix which showed as a straight white line. At the points where the sutures transfixed the peritoneum were small masses of lymph.

On the other hand I found in the upper part of the wound (which had been treated by the extra peritoneal method, the muscles and integument being united by sutures which left the peritoneum widely asunder), the intervening space was filled with large masses of lymph which had been thrown out to fill the gap between the cut surfaces of the peritoneum. The adjacent intestines were adherent to the wound.

It appears to me, from this experiment, that it is always best, in closing the abdominal wound, to carry the needle through the integument, muscles and peritoneum in such a way as to bring the two surfaces of the peritoneum with the cut portions of the integument and muscles in contact; also that where the peritoneal surfaces are not approximated by sutures, there is great danger of the development of hernia.

In subsequent experiments upon other animals, chiefly rabbits and dogs, I opened the abdominal cavity by making a free incision in the median line of the abdomen dividing integument, muscles and peritoneum. These wounds I closed by approximating the integument and muscles only, leaving the peritoneum widely apart. In every case treated in this way, I found that large hernial protrusions followed. Hence I believe it safe to say that the peritoneum is a guard against abdominal hernias.

I believe also, that in cases of femoral and inguinal hernia, were efforts more commonly made to suture the surfaces of the hernial sac, a radical cure would more frequently follow the operation for relief of strangulation.

Many surgeons writing of the radical cure of hernia lay great stress upon suturing the margins of the abdominal ring together; but in no small number of cases which have come under my care I found it quite impracticable to approximate the dense tissues composing the abdominal ring, and have had the closure of the hernial opening and cure brought about by the removal and closure of the peritoneal sac which invested the hernia. In these operations the peritoneal cavity has not been opened, and no dangerous consequences have been observed.

ABDOMINAL MUSCLES AND HERNIA.

In studying the effect of injuries upon the abdomen, it is important to know the anatomy of the abdominal muscles and to have such knowledge with a great deal more thoroughness than has been attained by practitioners now and then (happily rare cases) in this age and country of haste and "hustle."

The manner in which one set of muscles aids another set, makes the best possible support for the abdominal contents, as the fibres of the external oblique, internal oblique and transversalis, cross each other at nearly right angles thus meeting all the con-considerations of strength and mobility.

The consequence of dividing any one set of these muscle fibres is a great weakening of the abdominal wall, and hernia often follows.

For the purpose of ascertaining how far the phenomenon of coughing might be checked, by dividing abdominal muscles and using dogs as my subjects, I had occasion to divide the *rectus abdominis* and the external oblique with the tenetome. Such wounds healed very quickly, I found, and without leading to hernia, but upon dividing the deeper layers of muscles with the purpose of further checking their action during a spasm of coughing, a ventral hernia was made by the peritoneum quickly bulging out into the opening caused by the divided muscles.

It is of great importance in seeking for the radical cure of hernia, to know the relation of these muscles to each other.

After the hernial sac has been restored to the cavity of the abdomen, the operator, by taking pains to divide and break up the sheaths of the several muscles about the hernial opening and by applying sutures in such a manner as to force one muscle over another muscle and one tendon over another tendon, will find the abdominal rings to be perfectly closed and the cure of the hernia will be complete.

LAPAROTOMY FOR STRANGULATED HERNIA.

A study of the normal anatomy of the abdominal walls gives but slight information as to the correct method of dividing the point of constriction and as to the relation of these abdominal rings (so-called hernial openings), to the gut, as illustrated in a majority of hernias. Hence, a brief study of these abdominal muscles is incomplete without a few words in regard to the operation for the relief of strangulated hernia.

In cases of hernia above Poupart's ligament, the advice to cut upwards is based solely upon the fear of wounding the arteries which may encircle the hernial sac.

In cases of hernia below Poupart's ligament, or femoral hernia, the general advice is to divide the constricting point by cutting against Gimbernat's ligament in a direction inwards and upwards. In this case, the danger of wounding the femoral vein or the saphenous vein or any of the arteries of an irregular origin is so great, and the danger which follows hemorrhage into the peritoneal cavity is so certain, that the writer considers it is better surgery to relieve the constrictions of the bowel in these cases, by dividing them from the peritoneal side. To do this, it is course necessary to make a laparotomy instead of opening the abdomen through the groin.

The line of safety—the median line of the abdomen—is safe, because there is no danger of wounding any important blood-vessels or muscles.

The constricting fibres of hernia can be more easily divided through it, and from the interior of the abdomen than from the exterior and through the important muscles. This the writer knows, not from experiments upon dogs alone, but from repeated successful operations upon human sufferers.

CHAPTER V.

LAPAROTOMY FOR GUN SHOT AND BAYONET WOUNDS.

In this study, the next and most interesting subject calling for our attention is that known, technically, as enterotomy, which means the cutting away of any portion of the intestine which may have been rendered incapable of performing its functions. To learn how to do this work so that one may obtain the smallest number of failures, it is necessary to make repeated trials upon the lower animals.

In making my gun-shot wounds of the intestines, that I might find the best treatment thereof, I used a dog, and having rendered him absolutely quiet by anæsthesia, so that my aim was certain, I fired a shot from a small, common rifle, carrying a 22-calibre ball, being at a distance of about 20 feet from the dog and aiming sufficiently low to avoid the liver, and so that the ball might traverse the abdomen from right to left.

The wound having been made, I opened the abdomen by a section in the median line to find the intestine perforated in eight different places, also two wounds in the parietal peritoneum. Hemorrhage from some of these wounds, particularly three which transversed the mesentery, was copious and would have been fatal had I delayed my abdominal section longer. The hemorrhage was at once controlled by ligating the bleeding arteries. The intestinal wounds proper were treated by folding the mucous membrane which protruded through the peritoneal investment of the intestine back into the cavity of the bowel and passing the sutures through the peritoneum in such a way as to close the wound by approximating two peritoneal surfaces.

A large number of sutures were required to close all of the intestinal wounds. After the sutures were tied the knots were cut short, the material used being fine carbolated silk. This animal recovered and was subsequently killed. The autopsy showed that some of the sutures had sloughed through the cavity of the bowel and were carried away, while others were encysted.

In the treatment of gun-shot and other wounds of the abdominal cavity, it is often a serious matter to ascertain whether the intestines are wounded. It is especially the case with police department surgeons, city poor surgeons and hospital surgeons,who are most frequently called upon to take charge of men who, in street brawls, riots, and the like, are wounded in these parts.

One who has searched post-mortem for bullet wounds of the intestines knows how uncertain he is as to whether or no all the openings have been found, until he has injected the bowels with water, which escapes at the point wounded.

In the treatment of these wounds by suture, it is most essential that all openings should be discovered and sewed up, else, after closing several, one wound that remains undiscovered and unclosed will allow the intestinal contents to escape into the peritoneal cavity, killing the patient.

In the treatment of a living subject for such wounds, water cannot be used, because it will wash the intestinal contents into the peritoneum.

Hence, the use of hydrogen gas by Nicholas Senn, as an inflator of the intestine for the purpose of ascertaining whether and how frequently the intestines are wounded, is a superb improvement on the old and doubtful method of eventeration, turning the bowels out upon warm flannels, etc.

The Senn method is easy, safe and certain, and may be illustrated upon a dog by securing him, anæsthetizing and shooting him in the manner heretofore described. Then introduce a tube into the rectum, said tube being connected with a bag holding two or three gallons of hydrogen gas, which has been made by treating metallic zinc with sulphuric acid in a Marsh apparatus. By compressing the bag, the gas can be driven into the rectum, and can traverse the intestine until it escapes to the abdominal cavity, thence to the wound and out. The escape of the gas through the wound may be ascertained by holding a flame at the wound, by means of which the gas will ignite.

In making an investigation of this character—where it was demonstrated that the intestine had not been wounded, that only the abdominal cavity had been penetrated—the gas traversed the entire intestinal cavity from anus to mouth, proving conclusively that there was no opening between those points, through which the gas might have escaped.

BAYONET WOUNDS.

The practitioner who has to deal with knife wounds, wounds made by pitch-forks and similar weapons and implements, thus gets in time of peace a practice similar to that which came so liberally to the army surgeon during the recent war. In making my investigations as to wounds of this class, I used a sharp, triangular-shaped bayonet peculiar to the Belgian musket, its greatest diameter being about one inch. The wound was made upon a dog and was carried through the abdomen to a point where the bayonet measured about three-fourths of an inch. After withdrawing the bayonet, two hours was allowed to elapse before any treatment was resorted to. (A lapse of time liable to occur in ordinary practice between the infliction of the wound and the arrival of the surgeon.) Then the abdomen was opened by a section in the median line. The cavity of the peritoneum was found to contain a considerable quantity of intestinal matter which was carefully removed and which had issued, it was found, from four wounds which the bayonet had made in the intestinal wall.

These wounds were closed by sutures made with carbolated silk and passed in the same manner as in the preceding case. The wounds in the parietal peritoneum and in the abdominal section, were also closed by sutures made of the same material.

This dog did well until the second day, when he gave signs of serious disturbance and died the following day.

The autopsy showed that the intestinal wounds were pulled up to the parietal peritoneum and that they had adhered, also, to the sound portion of the bowel by the plastic exudate that had sealed them perfectly. There was no escape whatever, into the peritoneum, of intestinal matter, the union of intestinal wounds by suture, having been absolute. Some bloody serum was present in the abdomen.

Had this operation for the closure of the intestinal wounds been made earlier, the chances of recovery would have been much greater.

CHAPTER VI.

VARIOUS INTESTINAL SUTURES.

Among writers on intestinal surgery, there has been much discussion as to the best method of suturing wounds of this class.

In my own investigations I have made a large number of abdominal sections on rabbits, excising a portion of the intestine and uniting the surfaces in various ways by means of sutures for the purpose of ascertaining the best mode of securing a perfect union of the wounds. It is not necessary to give in detail the history of these experiments, but the results established beyond question, in my mind, that the suture should pass through the peritoneum and the fibrous coat of the intestine, and not penetrate the mucous membrane.

It should begin about one-quarter of an inch from the margin of the intestinal wound and should come through the peritoneum at the edge of the intestinal wound. It should then be carried across the wound and again penetrate the peritoneum near its edge and after embracing about a quarter of an inch. When it is tied two surfaces of the peritoneum are approximated; the mucous membrane is thrown into the bowel and the cut surfaces of the peritoneum are in perfect apposition.

The suture should be of fine material and should be introduced at intervals of one-fourth of an inch. A suture of this kind, so far as my own experience teaches me, has never permitted the escape of intestinal contents and if sloughing occurs it is most likely to open into the cavity of the intestine.

It sometimes becomes necessary to divide the intestine in its long diameter, for the removal of foreign bodies and in that case, the same principles so far as the approximating of the cut surfaces of the intestine is concerned, should be observed and practiced.

A dog whose stomach I had filled with fragments of broken brick for the purpose of testing the feasibility of removing foreign bodies from the stomach or intestines, like the famous "fork case" which occurred in France some years since (vide Le Progres Medicale, 1875), was the next subject of investigation. The pieces of brick were forced into the stomach, *per vias naturales.*

The abdomen was opened on the median line and an incision of about two inches in length was made in the anterior wall of the stomach parallell with its long diameter. Large numbers of the terminal branches of the gastric arteries were divided and bled copiously, so that each one required twisting to check the hemorrhage.

Through this wound the fragments of brick were removed and the wound was closed by sutures of the kind last described. No difficulty of a particular character followed, the animal making an uninterrupted recovery.

INTUSSUSCEPTION.

For the purpose of learning what might be done toward a successful union of the bowels in cases of intussucsception, valvulus or any condition which has destroyed a large portion of the intestine, I chose a medium sized dog and made a section of his abdomen. Taking the intestine between the thumb and finger of my left hand, with a scalpel handle I pushed that portion of the intestine above my fingers, downward and between my fingers in such a way as to invaginate it in the part below. I was surprised at the difficulty of carrying out the procedure and after repeated trials I found it impossible to produce an obstruction of the bowel by this telescoping process, which would not readjust itself immediately the telescoping pressure was removed.

However, I found I could invaginate four or five inches of the bowel and the reason why a greater extent of the bowel could not be invaginated, I also learned, was that the mesentery rolled up in an accumulated mass too large to enter the intestine at the point of invagination.

ENTERECTOMY.

I excised with the scissors by direct incisions, five inches of the bowel and noted the following conditions:

1. A serious hemorrhage from the mesentery, which required eight ligatures to control the bleeding arteries.

2. I found on approximating the cut ends of the bowel, that the mesentery, as I had stripped it from the bowel, accumulated in such a way as to prevent the easy approximation of the surfaces, by suture.

EXCISION OF THE MESENTERY.

So large an extent of the mesentery rolled up between the cut ends after I had joined them with interrupted sutures, beginning with the mesentery on one side and running around the surface of the bowel at a distance of one-quarter of an inch, that I was compelled to excise a V-shaped portion of the mesentery, carrying the incision down from the margin of that organ to its point of attachment to the spine.

In making this section of the mesentery but three arteries required ligature, while by the other method, it will be observed, I was obliged to apply eight. The cut surfaces of the mesentery were approximated and fastened by two sutures. This operation was followed by recovery and a subsequent post mortem examination showed a considerable contraction of lumen of the bowel at the point where the cut surfaces were united. The mesentery contained two knots, which, on section, were found to contain the sutures with which the V-shaped section of the mesentery had been closed.

If, in making a complete section of the bowels, a section measuring more than two and one-half inches in length is made, it is best to carry the incisions down in a V-shaped direction to the root of the mesentery as before described. Perfect coaptation of the cut ends of the bowel may be greatly facilitated by the removal of the intervening excess of mesentery, hence it is only necessary to state this fact without further urging to adopt the practice in operations of the character under discussion.

The practitioner cannot, however, rest content and easy in regard to any such union of the bowel until he knows beyond peradventure, that the two peritoneal surfaces are in contact in every part of the circumference of the bowel. The smallest opening or protrusion of the mucous membrane makes an intestinal opening through which the intestinal contents, liquid, solid or gaseous, may escape to set up a fatal peritonitis.

A practitioner cannot get too much practice in joining the cut ends of the bowel by sutures in such a way as to give those cut ends the best possible chance for healing together. This practice is not always at hand, indeed, it is somewhat of a rarity in the general practice of the average physician, in consequence of which, the student practitioner who seeks to keep abreast of the times is forced to avail himself of the resources—the dogs, rabbits, etc., and vivisection—which nature has placed at his disposal.

COLOTOMY.

This operation, liable to meet any practitioner, is made necessary by obstruction in some part of the large intestines which prevents the normal evacuation of the bowel, an obstruction most frequently caused by cancer.

In cases of cancer affecting the rectum or the sigmoid flexure, the colon is most easily reached by an incision made about midway between the crest of the ilium and the termination of the last rib, parallel to the anterior border of the quadratus lumborum muscle.

An incision carried through the abdominal wall at this point strikes the colon, and when that intestine has been incised and its contents evacuated, the margins of the intestinal wound should be carefully sutured to the margins of the abdominal wound. This procedure constitutes a colotomy.

There are two methods of doing this work, when a man is the patient, and one is to make two operations of the procedure.

First. Make the incision through the abdominal wall, exposing the intestine, then carefully suture the peritoneal coat of the intestine to the peritoneal margin of the abdominal wound, thus obtaining a perfect blending of the two peritoneal surfaces to prevent the entrance of foreign matter into the abdominal cavity.

Second. When these two surfaces have blended, divide the intestinal walls and penetrate the cavity of the gut, making an artificial anus.

To accomplish this operation by either of the above methods very much depends upon the handling of the sutures, and no person should undertake the operation who has not repeatedly tried it upon dogs and rabbits.

To make a colotomy upon the dog the same relative anatomical locality is selected.

First, find the crest of the ilium, then seek out the anterior part of the quadratus lumborum muscle, and cut through the abdominal wall until the peritoneal cavity is reached.

The colon will be found in the bottom of the wound and can be easily drawn into it.

Now thread the needle and carefully suture the peritoneum to the side of the wound, putting the sutures apart a distance of about one-quarter of an inch and carrying them through skin, muscle, peritoneum and peritoneal coat of the intestine.

Cut all the sutures short and dress the wound according to the custom of the day, and wait four days until the blending of the peritoneal surfaces has become complete.

Then, make an incision through that part of the colon which protrudes through the wound, and the cavity of the gut is reached and the colotomy is complete.

For colotomy on dogs, rabbits or cats, the above description will suffice.

Speaking from a theoretical standpoint, some surgeons assert that it is best to select for a colotomy that particular part of a colon which is found adherent to the peritoneum of the abdominal wall and make the incision into the colon through that point, thus avoiding any wound of the peritoneum.

On lower animals at least this measure is quite impossible, while in practice upon man, with the modern methods of operating, the danger of peritoneal wounds resulting fatally, is so small, that operators need not attempt these theoretical or impracticable methods.

I very much question the possibility of making a successful colotomy in any part of the colon without opening the peritoneal cavity, and while I certainly should not attempt it I should feel perfectly safe, on the other hand, to leave my patient to the chances of recovery, in accordance with the methods I have just decribed and as revealed to me in practical experience.

CHAPTER VII.

EXCISION OF THE PYLORUS AND STOMACH.

It has been decided in recent years by aggressive surgeons that the pyloric portions of the stomach may be excised when invaded by stricture or malignant disease, but it is not the purpose of this section of my work, to discuss the merits of such procedures nor the causes which would make them warrantable.

I only desire to present to the tyro or whoever in the profession has not already done so, the means of familiarizing himself with the steps necessary in the performance of the operation.

I selected a large dog and made an incision beginning about an inch below the ensiform cartilage and carried it downwards to the umbilicus.

Through an opening made at this point, and in such a way, the stomach is easily reached and if not too comfortably occupied by the last meal, it may be withdrawn through the wound.

Now, to excise the pylorus, draw it through the wound and carefully isolate that portion of the *prima via*. Then with the scissors resect an inch in the long diameter, including the pylorus and a portion of the ascending part of the duodenum.

Many arteries will require ligature, the hemorrhage being profuse.

Now proceed to draw the gastric wound from the abdominal cavity and measure its length, when the two mucous surfaces are in apposition. Also measure the length of the wound in the duodenum.

If the wound in the stomach has proceeded any considerable distance from the pylorus toward the cardiac end, the stomach wound will be found a great deal longer than the wound in the duodenum, and in bringing the parts together it will be necessary to close up the gastric wound until it is no longer than the wound in the duodenum.

To do this, pass the sutures by simply carrying the needle through the peritoneal coat of the stomach, introducing it about a quarter of an inch back from the margin of the wound, and bringing it out from the peritoneum near the margin of the wound.

Then, reaching across the cut end of the stomach, pass the sutures in the same way upon the opposite side, introducing this suture a little less than a quarter of an inch from the margin of the wound.

Increase the number of sutures until the wound in the stomach equals in length the wound in the duodenum.

Next, begin a separate system of sutures, and in this follow the same plan of introducing the suture so far as the wound in the stomach is concerned, but instead of reaching across to the opposite side of the stomach wound, introduce the suture in a similar way in the wound of the duodenum.

Introduce these sutures at intervals of at least one quarter of an inch until the circumference of the duodenum is included.

Now, when the tying process begins, if the sutures have been introduced as I have here advised, the cut surfaces will protrude into the cavity of the stomach and the peritoneal surfaces will be in perfect opposition. There will be no puckering or pouting in any part of the wound whatever.

EXCISION OF THE CARDIAC END OF THE STOMACH.

Another very valuable and interesting study may be made by operating on a dog for a supposable case of a localized carcinoma of the cardiac end of the stomach.

Begin with an incision in the median line made near the end of the ensiform cartilage, and carry it down to the umbilicus. Then introduce two fingers of the right hand into this wound and pass them downwards into the left hypochondriac region.

Catch the cardiac end of the stomach and draw it through the wound.

By this procedure the spleen will be quite easily found and the freedom with which it moves about in the left side of the peritoneal cavity noted.

After the cardiac end of the stomach has been drawn nearly through the wound, proceed to excise with the scissors all that your judgement may mark as the seat of the disease.

To do this, grasp the edges of the wound in the stomach with the forceps and fingers, in such a way as to hold them upwards so that gastric juice or food which may be contained in the stomach may not escape into the cavity of the abdomen, to cause a fatal peritonitis.

(It has been asked: "What is one to do in case his resection extends so as to include the pylorus with the whole of the pyloric end of the stomach?" In reply, I say that the only limit to such an extensive excision is set by the operator's ability to ligate with sufficient rapidity the many spouting blood-vessels and to bring the cut ends of the stomach and intestines together.)

Now, all hemorrhage being controlled by means of ligature, torsion or the actual cautery, begin with the suture of Lembert and carefully close the wound.

The stomach, after the sutures have been tied, will be found to have lost nearly one-half its volume, yet there will be sufficient tissue to establish a perfect continuity between the œsophagus and the duodenum, and the dog's chances for recovery will be very good.

IMPORTANT CONSIDERATIONS.

The hemorrhage which occurrs from the operation just treated, is so great that the utmost pains must be taken to remove every particle from the peritoneal cavity, else clots from the wounded omentum will set up a fatal peritonitis.

Before attempting this operation upon man, practice it at least five times upon dogs. The similarity existing between the stomach of man and dog, so far as the mere anatomy is concerned, is so great that when one has accustomed himself to the manipulation necessary for carrying out excisions of a considerable portion of the stomach or pylorus, upon dogs, and had them recover from this operation, he need have no fear in performing the operation upon man.

So far as the technique of gastrotomy is concerned, it is limited almost to manipulation for the control of bleeding arteries and the introduction of sutures in closing the wounds.

Very little skill will be required in doing the cutting, but in making the different parts fit accurately, the one into the other, after the part supposed to be diseased has been removed, good judgment, a trained and practiced eye and no little deftness of touch and manipulation are necessary.

CHAPTER VIII.

DIGITAL DILATATION OF THE PYLORUS.

Digital dilatation of the pylorus may be practiced upon dogs and it will be found beneficial to the last degree in acquiring expertness in manipulation. To attain perfection in the manual features of this work, all that is necessary is to reach the pylorus through a wound in the abdomen and stomach of a dog,then gently pushing the finger through the pyloric constriction, estimate the resistance of the tissues so that dilatation without rupture through the pylorus may be obtained.

SPLEENOTOMY AND SPLEENECTOMY.

Through the revelations of the surgical operations just described, in the consideration of excision of the stomach and intestines, there is presented the feasibility and practicability of cutting into or cutting out the spleen.

As is well known, the spleen has in several cases been removed from man with benefit to the general health.

In consequence of this record, it is well for the student to investigate in the direction of so valuable a possibility.

In studying the operation of spleenotomy or spleenectomy, the relations of the spleen to the vascular system of the abdominal cavity must be ever kept in mind.

It receives a large splenic artery and from its hilum emerges numerous large veins which gather into large trunks and become part of the portal system. In man these same relative anatomical relations exist.

To reach the spleen, the incision may be made in the median line below the spleen, or parallel with the border of the ribs.

In most cases for which an operation on the spleen may be performed, the work can be done through an incision in the median line of the abdomen.

If the intention is simply to cut into the spleen and remove a tumor or foreign body, we only, when practicing upon dogs, make an incision in the abdominal wall, precisely as though we intended to resect a portion of the cardiac end of the stomach.

Through this wound the spleen may be drawn without fear of serious damage to any of its important vessels. An incision may be made freely into it. The result may be a copious hemorrhage, which, however, yields most readily to the liberal application of hot water.

The greater the hemorrhage, the hotter the water should be, because no other means (at least so far as my experience and reading teaches me), will so completely arrest a serious hemorrhage from the spleen tissue.

I have tried transfixing the margins of these wounds with sutures, and tying them in the hope of checking the hemorrhage from a simple incision in the spleen substance, but so great is the friability of the spleen that sutures or ligatures pass through its substances leaving fresh wounds.

The steady, persistent use of hot water applied by douche, direct to the wounded surfaces, in the majority of instances works admirably.

I have tried also to control this hemorrhage, by curetting the wounds with a blunt instrument, but without avail.

I have tried rasping the surfaces with a stiff, harsh tooth-brush, thinking in that way to tease out the wounded ends of the small vessels, but as with the other efforts cited, failure was the result.

The spleen is an organ largely supplied with peculiar contractile tissue, and upon this, water of a high temperature acts is such a way as to close the mouth of the bleeding vessels.

The details of this experiment will be found y interesting and instructive when carried out on

or complete removal of the spleen we need draw the organ a little more through the abdo- wound, and then by means of a round needle a strong ligature, transfix the splenic omentum t emerges from the hilum. Cut off the needle d tie the ligatures upon either sides of the parts netrated by the needle, including all the vascular ucture entering the spleen.

In the dog, this is one of the simplest surgical procedures that can be made in the abdominal cavity and is almost always followed by the recovery of the animal.

But when the spleen is diseased, when it has been very greatly enlarged by cystic degeneration or by general hypertrophy, the various vessels which enter and leave the organ may be so enormously enlarged that to prevent a fatal hemorrhage through the operation of removal, it will be necessary to pass the ligatures with greater care, exercising the utmost caution that the needle with its thread does not wound or weaken any vessel along which it may pass, and that in tying the ligatures no tension may be brought upon the long diameter of any of the included vessels, in such a way as to tear or break their continuity.

The inclusion of a large number of vessels in one ligature, will be dangerous, from the fact that they ramify to the most remote portions of the hilum and a great deal of tension would thus be brought upon the long diameter of some of the vessels, and their walls, being friable, would easily break down, permitting a hemorrhage into the abdominal cavity, perhaps after the abdomen had been closed.

CHAPTER IX.

CHOLECYSTOTOMY.

There are two methods of performing cholecystotomy; one of these consists in dividing the operation into two parts, viz.: the abdominal wound and stitching the gall bladder to the parietes of the abdomen, and waiting until the edges have grown fast before opening the viscus.

Thus, in substance, speaks a writer in the Encyclopædia of Medicine and Surgery by Ashurst, and he continues, practically, by saying:

The other method consists in stitching the gall bladder to the wound in the abdominal parietes directly it is reached.

When a man is being operated upon, an incision from three to four inches long is made in the epigastrium, either in the *linea alba* or along the outer border of the right rectus muscle.

All bleeding should be stopped before opening the peritoneum.

As soon as the gall bladder is exposed, its fluid contents should be removed by the aspirator, and afterwards the fundus, so as to permit of digital examination of its interior.

Care should be taken to hold the gall bladder well up into the wound so that nothing may escape into the peritoneal cavity.

After the calculi have been removed, the edges of the gall bladder should be stitched with continued sutures according to Tait, or with several interrupted sutures, to the edge of the abdominal wound, leaving quite free the opening into the gall bladder.

Finally, the rest of the abdominal wound should be closed in the same way.

Great care should be taken to pass the sutures through the whole thickness of the parietes, including the peritoneum.

There are several other points in this operation requiring the greatest caution, viz.:

1st. No part of the gall bladder should be cut away. The walls may be very vascular, and much hemorrhage has been known to follow their removal.

2d. If stones are found in the neck of the gall bladder, or are encysted in its walls, much care must be exercised in the attempt to remove them or the walls may be perforated, allowing the bile to escape into the peritoneum.

3d. If the calculus has adhered to the mucous membrane of the gall bladder, it will be better to leave it behind than to run the risk of killing the patient by tearing the walls of the gall bladder.

No attempt should be made to close the incision in the gall bladder so as to return the viscus to the abdomen, owing to the possibility that bile may escape through the stitches into the peritoneal cavity.

Granting that this risk is very remote, there is

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still danger and a more forcible objection; it is that the surgeon cannot be sure that the calculus has not formed in some part of the common or cystic duct, beyond the reach of forceps or fingers.

It is best to provide a cystic opening through which all bile or calculi which are not detected or which cannot be removed at the time of the operation, may subsequently come away.

It would be after the digestion of such opinions and directions as are given above,that the anti-vivisectionest woullgird on his armor and go forth to fight the advocate and practitioner of vivisection, but still he would have only his old weapon; the phrase, or argument as he would call it, of "vivisection is useless because you can find already in print all you can possibly learn by cutting alive."

It is, perhaps, true that every known surgical operation is described in print just as fully and comprehensively as Ashurst treats of cholecystotomy, but the argument ends there.

As well might it be maintained that a man might, through what he would find in text-books, agricultural newspapers, etc., become at once a successful practical farmer; or by the same methods become an expert chemist, a skillful watchmaker, or without investigation of and experiment with the actual factors, become a second Edison.

It has come to pass that a large number of physicians and surgeons claim that of all the numerous advances (or "revolutionary discoveries" as some are pleased to call them,) which abdominal surgery has experienced, there is none so sure, so free from hazard, nor so completely successful as the surgical treatment of gall stones.

This advance was made through experiment and investigation, and not at the cost of human life, and through it immeasurable relief from suffering, grief and pain is assured for all time to mankind.

How did they formerly treat the disease? Physiologists, long before surgeons assailed the gall-bladder, were accustomed to cut down upon this organ and after incising it stitch it to the margins of the wound, passing a ligature about the common duct and establishing a genuine biliary fistula for the purpose of studying the value of bile in the animal economy.

Their work, however, was done upon dogs and rabbits; dogs making the best subjects, owing to the fact that the gall-bladder in them is larger.

Ample experience in manipulation is the chief requisite for success when a practitioner desires to carry out the general plan of cholecystotomy in man. To achieve the same result on dogs, the same system is practiced, as follows: make an incision in the abdomen parallel with the external border of the rectus muscle and nearly opposite the umbilicus.

This incision should vary in length from an inch and a half to three inches, according to the size of the animal.

Pushing aside the omentum, the gall bladder will usually be found as a small, greenish looking cyst, adherent in the bottom of the wound. It can easily be drawn into the abdominal wound and its contents removed by aspiration, when a small opening can be made through it with a knife or scissors. It can be attached to the margin of the wound by interrupted or continued sutures as the operator thinks best.

In some instances the external incision in the abdominal wall may be so long that if the gall bladder is sutured to the lower angle of the wound, the tension upon the sutures will be too great to permit of proper union. In that event it is better to close up a part of the abdominal wound by interrupted sutures, until that portion of it is reached where the gall bladder may be returned into it without undue traction.

Before this measure can be performed successfully—that is, the animal making a good recovery—several dogs will be sacrificed while the operator is learning to do the work.

So sensitive is the peritoneal cavity to the smallest portion of bile that a fatal peritonitis very easily developes.

An excellent illustration of this fact was met by my friend, Dr. J. E. Clark, of this city. The case was of a robust workman, who, while engaged in lifting some heavy object, suddenly felt something give way in the right side of the abdomen in the region of the gall bladder. He immediately suffered pain, which gradually became more and more intense, and which speedily led to collapse, and after twelve hours, to death.

On opening the peritoneal cavity the doctor found the patient had sustained a rupture of the gall bladder, and that through the small rent a considerable quantity of bile had escaped into the peritoneal cavity, causing death as stated.

ABSCESS.

Collections of pus in the abdominal cavity are so common and so serious that the surgeon cannot be too studious in considering them. Not infrequently they commence outside the peritoneum, behind or beneath it, and by gradual enlargement extend into the cavity of the abdomen, pushing aside the viscera and behaving very much like cysts of ovary or broad ligament.

The history will usually enable the surgeon to distinguish these abscesses from the tumors mentioned, but sometimes their growth is so slow and chronic, and the history so free from pain, that diagnosis is difficult. I have been anxious to know more of their history and nature than the accessible literature contained. I have read about the staphylococus and how it grows in colonies when properly cultivated. Some years ago I had a patient, a lady, who had been sick for several weeks, who had always suffered intense dysmenorrhœa and scanty menstruation. She had a large tumor in the abdomen. It rose up out of the pelvis and pushed the intestine before it until it almost reached the ensiform cartilage. When it was percussed it gave a dull flat note but in either loin there was distinct tympanitic resonance. The tumor looked, felt and percussed like an ovarian cyst. But the patient had slight fever every afternoon, and gradually weakened as the tumor grew. She moaned in her sleep, and when roused or moved uttered a low plaintive cry—*misera physiologique*—that indicated the presence of some wasting disease. I diagnosed abscess of the peritoneal cavity and opened it by free incision in the median line of the abdomen 14 quarts of pus were discharged and from the bottom of the cavity a diseased ovary and fallopian tube were removed. A part of this pus was injected into the abdomens of two dogs by means of a needle. A third dog had a half ounce injected behind the pelvic peritoneum by making an incision near the crest of the ilium until the peritoneum was reached then turning that organ aside pushing the syringe nozzle downward behind the pelvic peritoneum into the connective or cellular tissue. None of these animals treated in this way developed serious illness. In vain I searched their abdomens to find a fluctuating tumor. The pus must have been sterile or the tissue of the dogs lacked some necessary element for the growth of pus. I have poured putrid pus into the peritoneum of other dogs without making mischief. I do not believe there is ordinarily room enough in the cavity of the peritoneum to contain sufficient oxygen for the growth and development of many of the lower forms of life.

FUNGI DO NOT GROW IN THE PERITONEAL CAVITY.

Believing the growth of various fungi which are common upon walls and dead animals might have some bearing upon the death of individuals who have perished after intraperitoneal surgical operations, I made the following experiments: Quantities of mould were collected from a cellar wall, a manure heap and the dead body of a cat.

Three dogs were placed in the trough anæsthetized, their abdomens opened and the fungi carefully transplanted to the peritoneal cavities. The animals were then carefully cared for and observed twice daily until they recovered. No unusual symptoms were observed. The treatment of the peritoneum in this way does not appear to interfere with its ability to repair damage, for when these dogs were killed, two weeks after the experinent, no trace of spores or mycelium could be found. Some of the fungi in these experiments were found to be of the families known as *Hyphomycetes*, *Physomycetes*, individual known as *Rhopalomyces candidus* and *mucor caninus*.

ABSCESSES DEVELOPED IN THE ABDOMINAL CAVITY.

By injecting a few drops of urine which had undergone ammoniacal decomposition into the subperitoneal tissues of dogs, abscesses were caused to develope and encroach upon the peritoneal cavity. This was done by anæsthetizing a dog, making an incision in the wall as for a colotomy and injecting the ammoniacal urine into the connecting tissue along side the colon where that organ projects through the peritoneum and attaches to the abdominal parietes.

Similar injections when thrown into the connective tissue about the kidneys are likely to cause abscesses in dogs which may be observed and studied through the abdominal wall. The injection of aquæ ammonia, tr. of iron, dilute sulphuric or nitric acids into the subperitoneal connective tissue is likely to be followed by the development of abscesses.

PERITYPHLITIC INFLAMMATION AND ABSCESS.

When any of these substances just enumerated are thrown into the connective tissue which binds the cæcum to the abdominal wall of dogs, then follows pain, inflammation and tumor quite similar in character to that which we see in man and called perityphlitic inflammation and abscess. Then abscesses may encroach upon the peritoneal cavity until the small intestines are pushed beyond the umbilicus or they may leave the abdomen passing under Pouparts ligament and distending the fascia of the thigh and extending into the leg. If the intestine is perforated gas will pass into the connective tissue of the region giving a peculiar crepitation.

CHAPTER X.

CHOLECYSTECTOMY.

It is possible that the walls of the gall bladder may be so diseased or so injured during the progress of a surgical operation, that the danger of hemorrhage or sepsis makes the retention of the organ in the peritoneal cavity, unsafe. Occasionally it occurs that the parieties of the gall bladder may contain a number of encysted stones whiah threaten perforation and which cannot be removed without jeopordizing the integrity of the gall bladder walls. In such an instance it is well to remove the gall bladder entire.

To do this the liver and the diseased gall bladder may be brought into the wound by pushing aside the large intestine. Then, after putting a ligature around the cystic duct, it may be divided with a few strokes of the knife or scissors, taking care not to wound the liver when detaching the gall bladder from its natural adhesion to that organ.

For this operation made upon a dog, you make the incision in the abdominal wall exactly as for cholecystotomy. The technical training consists chiefly in the separation of the gall bladder from the liver, so, in the dog you draw the liver upward and its free edge into the wound, thus making the whole gall bladder and cystic duct as available as possible. Then, with the liver grasped between the thumb and foreabove the *symphysis pubis*, thus wounding the organ after the bladder had been distended by a syringe injection of warm water.

In operating upon a medium sized dog—one weighing about 30 pounds for instance—the bladder will be found at a depth from the front wall of the abdomen, of not more than one inch and it is not likely that such a wound will injure any other organ than the bladder. Thus is permitted the escape of the fluid contents of the bladder into the peritoneal cavity and the effects of the presence of urine in this cavity, may be studied conveniently and well.

In closing wounds of this character I have used every variety of sutures, but with the best results attached to the use of the Lembert suture. With this suture the two surfaces of the peritoneum are carefully approximated leaving the cut edges of the wound to discharge their fluids into the bladder to be carried away with the flow of urine.

Practitioners have found it a very rare occurrence to observe a rupture of the bladder from external causes and frequent efforts to produce the phenomena upon lower animals have been made without success. My own experience in this direction, which has been frequent and varied, has failed to show me such a case, but I have succeeded in causing this viscus to give way, by injecting through the urethra into the bladder a quantity of water which was further compressed until the walls of the bladder yielded to the pressure of a strong piston.

finger of one hand and the gall bladder held by the other hand, the latter is separated from the former.

If a careful division of the peritoneum, where it reflects from the gall bladder to the liver, is made, very little hemorrhage follows the process of stripping the gall bladder away from the liver and a ligature being now passed and tied around the cystic duct, the gall bladder may be removed.

The ligature is passed and tied for the purpose of preventing a reflux of bile from the hepatic duct into the cystic duct, thence to the peritoneal cavity.

It has been the experience of the writer to know numbers of operations of this kind upon dogs, where the liver was extensively wounded and its capsule of Glisson sutured, and yet where the healing proceeded without interruption.

CYSTOTOMY AND BLADDER WOUNDS.

It is occasionally demonstrated, in the course of operations for the removal of tumors from the cavity of the abdomen, that the bladder is adherent to the tumor in such a way that it is either torn accidentally or its incision becomes necessary.

While important technical knowledge and skill may be learned by making such wounds in the bladders of brutes of a lower life scale than that of man, such wounds, it may be stated at once, should always be closed by suture. Repeatedly have I thrust a knife through the front wall of the abdomen just above the *symphysis pubis*, thus wounding the organ after the bladder had been distended by a syringe injection of warm water.

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In each instance I found it necessary, before the walls of the bladder could be broken down, to fasten the urethra to the nozzle of the syringe, because otherwise that canal would yield, allowing the fluid to escape at the side of the nozzle before sufficient pressure could be brought to bear upon the vesical wall to compel it to give way.

In other instances I have distended the bladder to the last degree, and then by the application of blows and pressure through the abdomen, by the exhibition of emetics to further force violent contractions of the abdominal muscles, have given hypodermatic injections of strychnine with a view of inducing tetanic spasm of the muscular system; all these in the expectation of producing a rupture of the bladder, but without success.

Yet, as commonly recorded in the various works upon surgery, the history of this accident—the rupture of the bladder from external causes—places doubt in reference to its occurrence entirely out of the question.

In cases where the surgeon has reason to think, as a result of his manipulations with the catheter, the lithotrite, or other instrument, that the bladder has ruptured and the contents thereof have escaped into the peritoneum, his duty is to open the abdominal cavity by a section in the median line, from the umbilicus downward until the bladder is exposed through the wound.

The bladder should be thoroughly examined and the rent sought out and closed by interrupted sutures.

In the high operation for the removal of stone from the bladder, should the peritoneal cavity be opened accidentally and urine escape into it, the operator should enlarge the opening into the peritoneal cavity or by other means; be sure it has been perfectly drained.

CYSTECTOMY.

The legitimacy of cystectomy—extirpation of the bladder—has hardly been established. It is a resource about which Italian surgeons are just beginning to think and speak. While it is somewhat uncertain as yet, in its relation to man, it can be performed upon dogs with quite uniform success.

My method is as appended: Open the abdomen from umbilicus to the *symphysis pubis* and empty the bladder by pressure. Pull the intestine out of the pelvis and find the ureters. After they have disappeared in the retrovesical fold of the peritoneum, divide them. Continue the dissection through this fold until the rectum is perforated at a point where it will most easily receive the proximal ends of the ureters, and fasten them in the rectum by fine silk or cat-gut sutures.

The bladder may now be removed by carrying an incision around it near enough its apex, and through the peritoneum only, so that membrane may be closed by sutures after the enucleation has been completed.

A few arteries will require ligatures as the tissues about the urethra and base of the bladder are divided. In some dogs I have found it necessary to make a transverse incision through the *rectus abdominis* and pyramidalis muscles near their insertion into the pubis, at right angles to the primary incision in order to get room to apply ligatures and make incisions for removing the bladder from its attachments to the semphysis pubis and the deep perineal faciæ.

Were I making the operation on man I would hesitate to make a large transverse wound in this part of the abdomen.

Cancer, however, which could be almost the only excuse for such an operation, requires thorough extirpation and it is very doubtful if a good thorough operation could be made through an incision in the median line.

One will soon learn, after making a few of these operations upon dogs, that the mobility of many organs in the peritoneal cavity is not sufficient to enable one to operate with facility in all cases, through a wound in the median line, and to do the work with the best possible chance for success he must often incise the abdominal wall in the region nearest to the diseased or injured viscus.

CHAPTER XI.

NORMAL OVARIOTOMY, OOPHORECTOMY.

The study of this operation may be easily pursued on the lower animals, particularly upon dogs.

To perform the operation in the most approved manner is to make the section of the abdomen in the median line extending from the umbilicus down to the symphysis pubis. Then, by pushing the finger down into the cavity of the pelvis the uterus is easily felt.

The finger is carried upward and latterly in either direction above either horn of the uterus until the ovary is found in the iliac fossa. The ovary is now drawn upward through the abdominal wound, a ligature is passed around its attachment to the fallopian tube and broad ligament. With the scissors the ovary may now be excised and the stump or pedicle dropped back into the peritoneal cavity and the abdominal wound closed by interrupted sutures introduced according to the methods heretofore so often described.

This is the common operation of spaying practiced by farriers and swineherds. One of the latter is said by some writers to have been the first ovariotomist. He had become so proficient in extirpating the ovaries of his swine, that when his daughter, who had become unwise and unmanageable, seemed fairly on the road to lasting disgrace, he did not hesitate to perform the operation upon her and so save her and his own honor, at least so far as the results of illegitimate paternity could be provided against.

The operation of the removal of Fallopian tubes or the uterine appendages requires about the same attention to detail that is required in the operation just described. A study of the influence of ligation of the arteries easily seen to pulsate in the broad ligaments upon the nutrition of the uterus and ovaries, has proven very instructive to the writer, and suggests the usefulness of such an operation in cases where complete removal of the diseased structures is impracticable.

HYSTEROTOMY AND HYSTERECTOMY.

For valuable knowledge as to the technique of these surgical procedures for incision and excision of the uterus, I recommend the use of dogs. I do so because the influence of such operations upon the health of dogs is easily ascertained by experiment, the details of which suggest themselves.

PANCREAS AND LIVER.

As yet, the category of surgical procedures does not include operations on the pancreas and liver but the attention of the profession has been called to the possibility and practicability of doing something for the relief of abscess or malignant disease of the pancreas, notably by the controversy indulged in by the two Bells, concerning wounds of the pancreas and their surgical terms, in the early part of this century.

Wishing to collect a quantity of pancreatic fluid for physiological study, I experimented upon the pancreatic glands of lower animals to supply my want, and in doing this I followed the method described by Claude Bernard in his *Lecons de Physiologie Experimentale.*

In a medium sized dog the incision is made about midway between the umbilicus and the margin of the ribs, a little to the right of the median line. This is carried down through the abdominal muscles and the abdominal cavity opened.

The duodenum is exposed, and by drawing it through the wound the orifice of the pancreatic duct into the duodenum may easily be found; by raising the stomach the mass of pancreas is easily disclosed, and through such a wound every part of the pancreas is easily accessible. Dr. Senn, of Milwaukee, Wis., has made an extensive study of the surgery of the pancreas, making many operations upon dogs.

ON THE LIVER—HEPAPTOMY.

It is rarely that surgical diseases of this organ admit of incision, so that a partial removal of the liver is not likely to result in any good to the patient; but for the mere purpose of studying the effects of wounds upon this organ, the writer has, in animals, sometimes opened the front wall of the abdomen of a dog, in the median line, and isolated a portion of the liver with an elastic ligature.

The result of all my attempts at removal of a portion of the liver has been fatal.

The artificial production of abscesses by the injection of ammonia and other chemicals into the substances of the liver, has, in the hands of the writer, invariably proved fatal, although it is a well-known fact that abscesses when developing in this organ in the course of disease, are quite commonly opened by direct incision; and in yet other instances, work their way to the surface and discharge through the wall of the abdomen. It is doubtful if a more interesting field exists than in the experimental production of diseases of the liver, as the injection of irritants into the billiary passages, thereby causing inflammation, gives the observer an opportunity to make careful study of the influence of bile in the dog economy.

NEPHRECTOMY.

This is an operation upon the abdomen, although it is not usually upon a portion of the peritoneal cavity, for the removal of the kidneys.

It has, numbers of times, been successfully performed on man.

The presence of stones, abscesses or cysts in the pelvis, particles or minute portions of gravel may at any time make the removal of the kidneys (nephrectomy), or incision in its substance (nephrotomy), a surgical necessity, and our faithful friends, dogs and rabbits, afford excellent opportunity to acquire the manual dexterity necessary for the performance of the operation.

In addition, and quite fortunately, perhaps, that most frequent and puzzling disease, Bright's disease of the kidneys, may be studied in all its phases, by producing it artificially upon these animals.

In man, as in these lower animals, the operation of nephrectomy is usually made through the lumbar region in the posterior wall of the abdomen. The incision is made between the last rib and the crest of the illium, parallel with the external border of the quadratus lumborum muscle, resembling the incision that is made in the performance of colotomy.

When this incision is carried downward a sufficient depth, in dogs, the kidney is found in the bottom of the wound.

Through this wound the kidney is withdrawn. A ligature is passed around the renal artery and vein, in fact all the tissues that enter the kidney at the hylum, and by a stroke of the knife the organ is separated.

The constant fatality from disease of the prostate, in old men, has led the writer to attempt an operation upon the lower animals with a hope of devising a plan by which the urine might be diverted from the bladder, and that organ thus being at rest, facilitate recovery from diseased prostate.

This operation consists in making an incision in both loins of dogs, precisely as for the removal of the kidneys exposings the ureters, and then stripping them from their adhesions and dividing them; then fixing the proximal ends of the ureters in the wounds in such a way that the urine, instead of going downwards to the bladder, would constantly dribble away from fistulous openings in the lumbar region. Sometimes the kidney (nephrectomy) is most easily removed by reaching it through a wound in the median line of the abdomen. The peritoneum must be divided over the kidney before the extirpation can be accomplished.

LAPARO-ELETROTOMY.

The above term is used to designate an operation for the removal of the child from the uterus without cutting the uterus. It is an operation (laparo-eletrotomy) intended to take the place of cæsarian section, and it is done by making an incision from the spine of the pubis to the anterior spine of the ilium, then cutting through the peritoneum or pushing it up, the vagina is reached and opened and the child's head, if presenting by the head, is turned and delivered through the os uteri. It may be practiced upon sheep or dogs, the incision being made from the pubis to the anterior spine of the ilium of the animals, thus enabling the operator to introduce his hand into the pelvis and search for the vagina and incise it. He will, in doing this, observe how easily the bladder may be wounded in the removal of a child, through the operation of laparo-eletrotomy. Many of the successful cases of this operation have required subsequent operation for vesico-vaginal fistula and, no doubt, many of the fatal cases have followed extravasation of urine.

Good surgery would require one making this operation, to inject the bladder with warm water or to use other means to find a rent or cut in the bladder, and when found, close it with sutures passed through its peritoneal coat.

It is difficult, after comparing this operation with the cæsarian section, to see were the advantage over the latter is. There might be a fancied advantage if the peritoneum were not wounded, but such a result is quite improbable.

The absence of sutures and a large wound of the uterus and the avoidance of a copious hemorrhage which follows the division of the large uterine sinuses in the laparo-hysterotomy operation, one can easily see would be very favorable for recovery.

On the other hand, an extensive, incised, lacerated and contused wound of the deep pelvic connective tissue, as required in the operation of laparo-eletrotomy, woul dbe very likely to set up a very grave cellulitis.

THE UNION OF INTESTINAL WOUNDS.

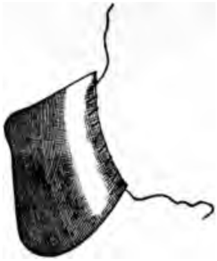
The early masters of surgery practiced the union of intestinal wounds by suture, and, indeed, it is not possible to give a fair conception of the different methods of employing intestinal sutures, without a reference, occasionally to those old masters and their methods.

In his work, called: "The Noble Experence of the Verteous Handy Werke of Sergeri," (London, 1525,) Jerome of Bruynswyke, says: "If that the wound of the belly is not grate inough, then shall ye make it grater, as I shall shew you hereafter; then shall you take out, properly, the guttes and sow it thereafter as it is nedeful with a Skymers nedyil. Jamericus, Theodoricus, Rogerius lay elder pypes in the guttes, under the seme, that the seme rotte not. WILHELMES and some others, lay therein a part of a ceyer of a throte gall of a beest, as the IV masters sayeth. But ZANFRANCUS & GUIDE they think it not be profytable, for nature is inclined to outdrawynge straunge thyngys and thus igt helpe not therefore it was layd, and it is better that the guttes be sowed, as afore is sayd, and that it be clensyed of the unclenes."

The four masters above-mentioned were practitioners in Paris, from 1235 to 1280, many years before JEROME wrote his terse work. They tried to unite wounded intestines by bringing the cut surfaces together over cylinders of dried intestine, bone, tallow, wax and almost anything that could be made to fill the lumen of the bowel and hold the cut edges in apposition. These various articles were expected to pass away by stool.

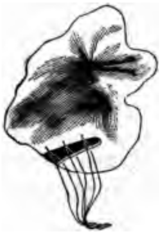
Certain rings and ferrules of metal to be used in accordance with the principles laid down by the four masters, were devised by other French surgeons; but now-a-days, no one thinks of resorting to such cumbrous methods. It requires just as much skill in the use of the needle, to sew the wounded bowel over any of those things as it does to make the suture of Lembert.

Glorei's suture is formed by passing the needle obliquely through the sides of the wound, when held together by an assistant.



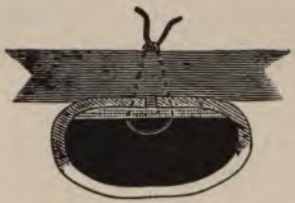
LOOP SUTURE OF LEDRAN.

Having prepared as many ordinary sewing needles and threads as wished, to make stitches, the edges of the wound well approximated, and each needle passed transversely to the line of the wound, the threads on each side being tied together, the two bundles were collected and twisted into one, so as to pucker up the edges of the wound.



LOOP SUTURE OF PULFYN.

A ligature being passed through the middle of the wound in the intestine, so as to leave a loop on its inside, the ends were left out of the external wound, so as to draw the serous coat of the intestines up to



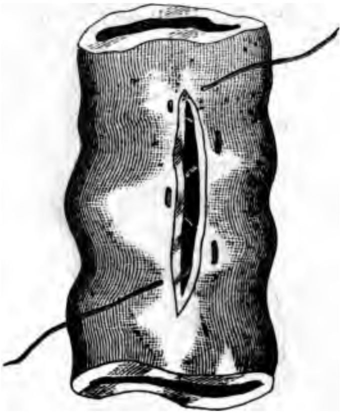
the peritoneum lining of the abdomen, after which the abdominal wound was closed and the threads fastened upon the skin by adhesive strips.

SUTURE OF HEYWARD.

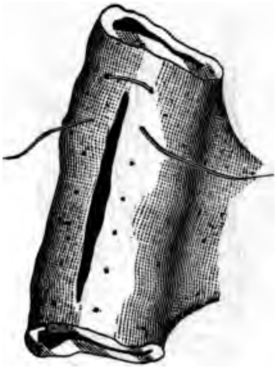
A small, thin and light piece of oiled wood, twelve to 15 lines long and four to six broad, being first introduced into the intestine at the wound, with a piece of thread attached to it, each end of the thread was armed with a needle. After passing each needle from one side to the other, from the inside outward through the thickness of the intestine, also of the abdominal parietes, the wooden plate was drawn upon so as to compress the peritoneal coat of the intestine against the serous lining of the abdomen, and close the wound hermetically. When the adhesions thus excited seemed to be sufficiently strong, (that is, in about three days) the thread was withdrawn, leaving the little plate of wood to be discharged by stool.

SUTURE OF GELY.

This famed surgeon, after cleansing the edges of the wound, turned in the serous surface on each side with the needle and passed the threads transversely through them at sufficient distances to keep the serous membrane of each side in contact. Then, the ends being knotted and tied as in the interrupted suture, were left to come away by stool, or they were twisted and brought out of the wound, as in the suture of Ledran.



The lips of the wound being approximated, pierce them both rather obliquely, about two lines from their edges and one from their extremity. Then repassing the needle in the same way, on the opposite side, two lines further on, continue them in the same direction to the other end by a series of equal stitches. The intestines being reduced, fasten the end upon the abdomen, and three days subsequently cut off one end of the thread near the wound and draw out the other.



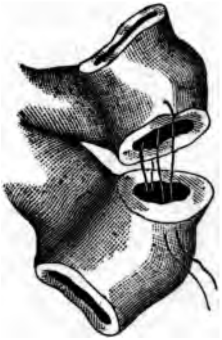
SUTURE OF LONGITUDINAL WOUNDS.

SUTURE OF RAMSDOHR.

Invagination of the two ends of the intestines being accomplished, this surgeon stiched them together by two or three points of the interrupted sutures; reduced the intestine and left the suture to the efforts of nature. If the mesentery interfered with the invagination, he excised it to a sufficient extent.

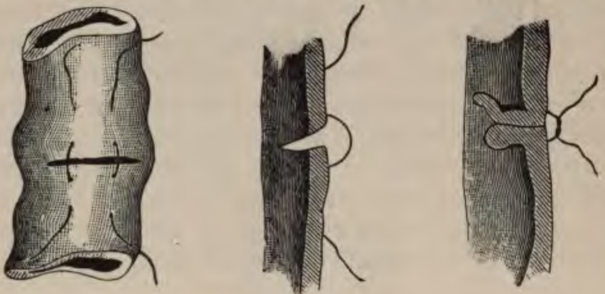
SUTURE OF JOBERT.

Jobert operated as follows: With a piece of silk passed into a needle, he transversed the anterior part of the upper end from without, inward, with one needle, and then passed both needles from within, outward, through the lower end of the intestine: After placing in this manner a sufficient number of threads to unite the wound, he invaginated the intestine by gentle traction upon the thread and either knotted them upon the outside of the inferior end or brought them out of the wound and the abdomen.

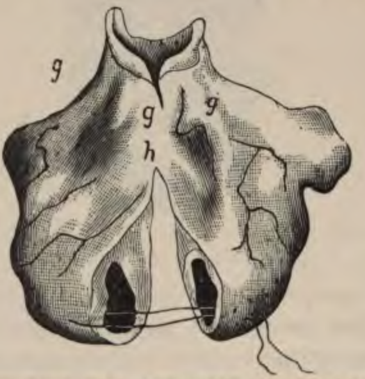


SUTURE OF LEMBERT.

After preparing as many threads, each armed with needles, as seemed requisite, one needle was pushed through the coats of the intestine as far as the mucous membrane from without, inward, and then repassed from within, outward; so as to come out about one line from the edge of the wound. Then passing it across the fissure, he carried it from without, inward, at a similar distance from the opposite side of the

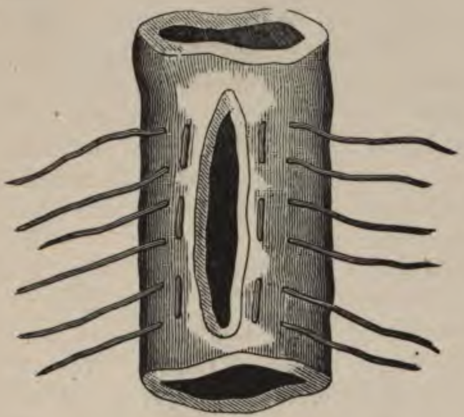


SUTURE OF LEMBERT.



TREATMENT OF WOUNDED INTESTINE, ACCORDING TO JOHN BELL.

wound and brought it out again at a distance of about three lines from its point of entrance. All the threads being passed in a similar way, the serous surfaces were brought in contact, so as to force the lips of the wound to double inward and form a sort of valve, after which the knots were tied, the ends cut off and the intestine reduced.



EMMETT'S SUTURE.

With threads, each provided with two needles; as many of these loops as the size of wound may require, are placed, and the opposite ends of the ligatures are tied together. Emmett claims that it obviates some of the weightier objections to the methods of Lembert.

TUMORS OF THE PERITONEUM AND ITS CAVITY.

A brief enumeration of the tumors which appear in the cavity of the peritoneum may not be out of place in connection with what has been written of the surgical methods of treating the peritoneum and the organs contained in its cavity.

The peritoneum is not infrequently the seat of solid or cystic tumors. The former are often malignant and secondary to cancer of other organs—says J. Knawley Thornton, to whose writings on tumors of the abdominal cavity I am greatly indebted.

Liver.—The only stages of cirrhosis, amyloid degeneration, carcinoma, simple cysts, abscesses, hydadids and carcinoma affecting one lobe rather than the the whole organ are diseases which can give rise to abdominal tumors.

Gall-Bladder.—Gall-stones are the most common cause of tumor of this organ. It is liable to distension from catarrhal occlusion of the duct, and is sometimes the seat of malignant tumors. Women are the most frequent sufferers from impacted gall-stones.

The mesentery is liable to the same diseases as the omentum. Its cystic growths are hard to distinguish from renal tumors.

Bladder should always be emptied with catheter to prevent distension which might be mistaken for disease.

Uterus.—Pregnancy, hydadids, moles,hydramnion cystic, and solid tumors, haematomta, abscess of the uterine wall, metritis may cause enlargements of this organ which need to be considered in studying an abdominal tumor.

Broad Ligaments.—Parorarian cysts, simple cysts, papilloma hydatids, cellulitis, abscess, petroma, sarcoma are liable to be found in the broad ligaments.

Round Ligaments.— Fibrous tumors sometimes grow to great size in these ligaments. They are said to be greatly elongated and to require removal or shortening in some cases of prolapsus uteri.

Ovaries.—Unilocular and multilocular cysts, dermoid cysts, fibroma, sarcoma and carcinoma, abscess and ovarian pregnancy cause abdominal tumors, which demand surgical treatment.

Sub-peritoneal cysts may arise in any part of the sub-endothelial connective tissue.

Encysted peritoneal effusion or dropsy may be the result of localized peritoneal inflammation.

Peritoneal Hematocele is caused by the rupture of a blood-vessel into the peritoneal cavity. Hematocele is sometimes retroperitoneal and are mistaken for aneurism of the abdominal aorta, owing to the fact that the rythmical movements of that vessel are apt to be communicated through the tumor.

Tympanitus is the distension of the abdomen with gas, which is usually contained in the intestines, but may, rarely, be found in the peritoneal cavity, where it may be detected by the presence of tympanitic resonance over the liver, when the percussion note should be flat.

Ascites.—The accumulation of serous fluid in the cavity of the peritoneum, as a result of disease of the heart, kidneys or liver, may complicate the diagnosis oftener, but it can usually be distinguished by the resonance of the intestine, which will float on top of the fluid, no matter what the position of the patient may be.

Phantom tumors are not easy to describe. They are often supposed to be pregnancy by the patient.

Pancreas.—Dr. Senn has shown in his admirable treatise on the Pancreas that this organ is sometimes the seat of malignant disease of cysts and abscesses, which, if properly recognized, may be treated surgically.

Spleen.—Abscess, cysts, hydatids, hypertrophy of the spleen occur as abdominal tumors. The disease, known as lukæmia, often induces great enlargement of the spleen.

Stomach.—Cancer is the disease which most frequently causes an appreciable tumor of the stomach. Foreign bodies, gas, food, and the condition known as dilated stomach, may cause a tumor of this organ.

Intestines. — Fecal impactions, valvulus, intussception, cancer, may form abdominal tumors, requiring the greatest skill to diagnose and differentiate.

Omemtum.—Tumors of this organ, in order of frequency, are said by Mr. Thompson to be cancer, hydatids, and simple cysts.

GASTRO-DUODENOSTOMY.

It sometimes happens that disease of the pylorus is of a character that will not yield to treatment by divulsion or extirpation. I mean those operations are impracticable and nutrition therefore cannot be maintained. In such cases life may be prolonged by the operation known as gastro-duodenostomy, *i. e.* suturing the duodenum below the seat of stricture or disease to the stomach above the seat of the disease, and thereby making an opening from the stomach into the duodenum through which food may pass. The technique of this operation is very important. It should he learned by repeated studies upon the lower animal. In principle it is simple and beautiful but in execution it is tedious and difficult.

You must fasten your dog on his back in the trough, cut through the front wall of the abdomen from umbilicus upwards until an opening is made large enough to withdraw the most prominent part of the stomach. Then a fold of the duodenum must be withdrawn. Now make an incision into the protruding stomach one inch and a half in length, and make a similar wound in the isolated duodenum. Bring the two wounds together and by means of Lembert sutures passed from stomach to duodenum proceed to sew the duodenum to the stomach in such a way that there will be a good sound union of the one organ to the other and yet an opening exist through which food may pass without taking the usual circulatory route by way of the pylorus.

It does not matter seriously in this operation whether you fasten the duodenum at a point above or below the opening of the bile and pancreatic ducts. These important fluids will reach the intestinal contents because the operation does not contemplate closure of the intestine. Its purpose is to give rest to a diseased part of the intestinal canal and to restore the nutrition which a diseased stomach or intestine has interfered with. Plates of decalcified bone have been advised by Dr. Senn as affording a quicker and safer method of performing this operation. They are prepared by treating the bone with dilute acids after it has been cut oval in shape and small enough to enter the cavity of the intestine, and has had a slit made in it for food to pass through. When all earthy matter is dissolved out these plates are dried, holes are punched in them and sutures are inserted. To use them one plate is put in the duodenum the other in the stomach, through the wounds made in those organs, the sutures are tied in such a way that they draw the two plates together and thereby clamp the organs firmly in apposition. Any part of the intestinal canal, ileo-cæcal for example, may be the seat of disease which may threaten life by interfering with the normal movements of the intestinal contents, which may be relieved by an operation which consists in sewing a part of one intestine to another so that a perfect anastomosis or inosculation takes place, permitting the free passage and movements of the chyme or chyle. No surgeon who aspires to work in the abdominal cavity can consider his education fairly commenced until he has made every variety of intestinal anastomosis upon dogs, and thereby familiarized himself with the practical details of this work. Not a few cases of obstruction of the bowels are due to a paralysis of a segment of the bowel caused by adhesion resulting from the healing of old typhoid ulcers. A removal of these cicatricial parts may not always be practicable owing to hemorrhage or the extent of bowel involved. In such cases an ileostomy or jejunostomy might save life and restore sound health. There is ample field for all the technical skill the student of abdominal surgery may acquire.

FINIS.

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